DEP-03

IMPROVED LUBRICATING OIL RECONDITIONING DEVICE AND PROCESS

Field of the Invention

This invention relates to lubricating oil reconditioning devices and processes for utilization with an operating internal combustion engine.

Background of the Invention

Filtering of circulating lubricating oil does not remove miscible liquid contaminants from the oil. These contaminants are mainly water and low boiling organic chemicals whose presence in lubricating oil cause engine corrosion and wear.

Lubricating oil reconditioning systems that are associated with an internal combustion engine and that function to remove such liquid contaminants from lubricating oil being circulated in the operating engine are known; see, for example, DePaul U.S. Patent Nos. 5,707,515 and 6,083,406. Although functional and effective, improvements in such systems would be desirable particularly to improve operational efficiency and reliability.

So far as is now known, no one has previously achieved a lubricating oil reconditioning system wherein oil from an operating internal combustion engine is first filtered and then passed as a thin film using gravity as a primary flow-inducing force over internal surface regions of a generally conically tapered heated platen, particularly a platen where a thin film is moved over platen internal surfaces that are arranged so that lower internal surface portions thereof generally have a smaller diameter than upper internal surface portions thereof. Preferably, the internal surface regions of the platen define a plurality of localized slope changes whereby the descending thin film of oil on the internal surface regions experiences a variable flow rate and a variable film thickness before reaching a bottom region where the resulting oil is collected and recycled for engine lubrication.

Summary of the Invention

This invention relates to new and very useful improved apparatus and processes for continuously accomplishing removal of low boiling liquids, such as water, from the lubricating oil of an operating internal combustion engine.

In accord with the invention, a side stream of circulating engine lubricating oil is processed continuously as the engine operates. The side stream usually and preferably comprises a minor fraction of the total quantity of engine lubricating oil that is being conventionally pumped through an engine, contacted with bearing surfaces thereof, and moved to a filtering zone.

In accordance with the present invention, either before or preferably after the filtering zone, a side stream of the engine lubricating oil is continuously removed, preferably separately filtered, and then conveyed to a volatile contaminant removal processing zone. In this processing zone, the side stream oil is continuously deposited upon upper internal surface regions of a preferably generally conically tapered, heated platen. A thin film of the deposited oil is formed on internal surface portions of the platen, and the thin film of oil flows downwardly thereover using gravity as a primary moving force.

The internal surface region of the platen is oriented so that lower internal surface portions thereof generally have a smaller perimeter or diameter relative to upper internal surface portions thereof. Preferably, the platen internal surface regions define a plurality of localized slope changes whereby the descending thin film on the internal surface regions experiences at local regions of the platen a variable flow rate and a variable film thickness. Oil reaching a platen bottom region is collected and recycled for engine lubrication usage.

Volatile components are evolved from the oil in the precessing zone, particularly as the oil descends as a thin film over platen interior surface regions, is separated and preferably vented. Preferably, the processing zone involves a chamber that is provided over the platen and that is over the oil input locations for the platen. The chamber can be defined by a housing. Vapors collecting in the processing zone

are conveniently released to the atmosphere through a relief valve, which is preferably a check valve.

To accomplish a generally uniform distribution of the filtered oil over the internal surface portions of the platen, various arrangements can be utilized. It is presently preferred to accomplish a substantially uniform distribution of entering oil over upper internal surface portions of the platen. This distribution is accomplished preferably by charging the filtered oil to a metering jet. Oil passing through the metering jet enters into a distributing chamber. The distributing chamber is preferably located centrally over upper portions of the platen.

From bottom portions of the distributing chamber, oil flows through a plurality of circumferentially spaced, radially extending tube members to a circumferentially extending, rim-like distributing tube that is horizontally oriented, located over upper portions of the platen, and is in preferably equally outwardly spaced relationship relative to the distributing chamber. The distributing tube is provided with a plurality of holes in its gravitationally lower portions. Thus, oil reaching the distributing tube flows downwardly out of the holes therein and descends to upper internal surface portions of the platen where the oil forms a thin film that downwardly flows thereover.

Conveniently and preferably, the platen is electrically heated to a desired elevated temperature by a resistance heating element or the like that is located on and about outside wall portions of the platen yet is inside of a housing, thereby isolating the heating element from direct contact with oil.

The inventive apparatus and method provide various advantages over the prior art. For example, the present conically configured platen in the inventive combination appears to provide improved thin film flow characteristics over its interior surface regions compared to the dome configured platen described in DePaul '406 (cited above), for example.

Other and further objects, aim, purposes, features, advantages, component substitutes, operating conditions, embodiments and the like will be

apparent to those skilled in the art from the present description taken with the associated drawings and the appended claims.

Brief Description of the Drawings

In the drawings:

Fig. 1 is a fragmentary diagrammatic view illustrating one embodiment of an oil reconditioning system of the present invention in functional association with the lubrication system of a fuel combusting engine;

Fig. 2 is a partial diagrammatic vertical sectional view through a presently preferred embodiment of an oil reconditioning system of the present invention;

Fig. 3 is top plan view of the platen employed in the Fig. 1 system;

Fig. 4 is an enlarged, longitudinal sectional view through a bracket employed in the Fig. 1 system to support the distribution pipe thereof;

Fig. 5 is a fragmentary plan view of the electric heating element employed in the Fig. 1 system;

Fig. 6 is a fragmentary bottom plan view of the oil distribution system employed in the Fig. 1 system;

Fig. 7 is a fragmentary sectional view taken through the distribution pipe employed in the Fig. 1 system;

Fig. 8 is a side elevational view of an alternative embodiment of a platen adapted for use in the Fig. 1 system;

Fig. 9 is a fragmentary longitudinal sectional view through the platen of Fig. 8;

Fig. 10 is a side elevational view of a further alternative embodiment of a platen adapted for use in the Fig. 1 system;

Fig. 11 is a fragmentary longitudinal sectional view through the platen of Fig. 10;

Fig. 12 is a fragmentary side elevational view of another pattern for a platen adapted for use in the Fig. 1 system;

Fig. 13 is a view similar to Fig. 12, but showing another platen sidewall pattern;

Fig. 14 is a view similar to Fig. 12, but showing another platen sidewall pattern;

Fig. 15 is a view similar to Fig. 12, but showing another platen sidewall pattern;

Fig. 16 is a fragmentary view similar to Fig. 8, but showing another platen embodiment; and

Fig. 17 is a fragmentary view similar to Fig. 8, but showing another platen embodiment.

Detailed Description

Referring to Fig. 1, there is seen one embodiment 20 of an engine lubricating oil reconditioning system of the present invention. In system 20, lubricating oil that has drained and collected in a conventional engine oil pan 21 is withdrawn by a conventional engine lubricating oil pump 22 through an interconnecting conduit 23 that incorporates a conventional lubricating oil screen structure 24 located in oil pan 21. From pump 22, the oil is passed to a main lubricating oil stream successively through respective conduits 26 and 27 into a conventional replaceable oil filter 28 or the like. The oil filter, if desired, may have a multi-stage core or may have multiple stages, such as three or five stages, for example, that may be encased in a housing.

In filter 28, oil under partial pump 22 pressure from conduit 27 is conventionally filtered to remove filterable contaminants, such as particulates including sludge; and the filtered oil passes into a conduit system 33 through which it is conveyed to engine bearings 34 for conventional lubrication purposes. From the

bearings 34, the oil drains down (not detailed in Fig. 1) and is again collected in the oil pan 21 for recycling through pump 22.

Conduits 26 and 27 are connected together through a by-pass valve or proportional flow divider 29 into two streams, a main oil stream in conduit 27 comprising more than 50 volume percent of the oil that enters and flows through conduit 26 and a side oil stream in conduit 31 comprising the remaining volume percent of the oil. The side stream that enters and flows through conduit 31 feeds into an embodiment of the oil reconditioning apparatus of this invention, such embodiment being generally designated by the numeral 32.

From conduit 31, the side oil stream under partial pressure generated by pump 22 enters into oil reconditioning apparatus 32 and is processed as described herein first to separate filterable contaminants and then to separate low boiling contaminants from the oil. The resulting processed and reconditioned oil exits from apparatus 32 through interconnecting conduit 36 and preferably passes (not detailed in Fig. 1) into oil pan 21 or the like for recycling and reuse in engine lubrication. The volatiles separated from the oil in apparatus 32 are discharged from apparatus 32 either into the atmosphere through vent 63 (which preferably is equipped with a check valve (not shown)), or into a conduit 37 for conveyance to the engine intake manifold (not detailed), or otherwise, as may be desired.

The system 32 is well suited for installation in combination with a previously manufactured vehicular engine or the like using a kit or the equivalent. Such a kit can comprise, for example, the proportional flow divider 29, components of the oil reconditioning apparatus 32 and the interconnecting conduit components, such as conduit 31. Observe that, in the system 20, one could consider that there are essentially two lubricating oil reconditioning systems, one system involving the main oil stream that is charged to conduit 27 and in which the filter 28 is used for oil processing, and the second system 32 involving the side oil stream that is charged to conduit 31 in which the apparatus 32 is used for oil processing. It is a feature of the system 20 that it can be functionally associated with a vehicular engine without

redesigning the originally installed lubricating oil system. Thus, usually even the originally installed lubricating oil pump (which is commonly located in the oil pan) can be used in operating the system 20.

Referring to Figs. 2-7, for example, the structure and operation of the lubricating oil reconditioning apparatus 38 is seen wherein low boiling volatiles are separated in the oil reconditioning apparatus 32 of this invention. Preliminarily, the oil side stream is filtered to remove particulates including sludge through a filter 35. In the apparatus 32, through a conduit 39 that extends in gas-tight relationship through a side portion of a top cap plate 41, a stream of filtered oil from filter 35 is delivered to and enters a central chamber 42 through a metering orifice or metering jet 43. The chamber 42 is defined by a generally cup-configured body 44 that has cylindrical side walls, an integral flat bottom and outwardly extending top mounting flange portions. Outer edge portions of the mounting flange portions that are adapted to lie flat against bottom edge portions of downwardly extending ribs integrally formed on under surface portions of the top plate 41. The mounting flange portions of body 44 are mounted against the bottom edge portions by machine screws 40 or the like that extend upwardly normally through the mounting flange portions into threaded engagement with the rib portions, although alternative configurations and mounting arrangements can be used, if desired.

Radially extending outwardly from a functionally interconnected relationship with bottom portions of the cylindrical side walls of body 44 are a plurality of straight, radially extending, spoke-like conduits 46 (preferably four, equally circumferentially spaced), as shown. Each conduit 46 terminally functionally interconnects with local circumferential surface portions of a circular tubular pipe 47 that is horizontally oriented, that is located above top edge portions of the platen 51, and that is preferably substantially coaxial with the body 44. Thus, portions of the circular pipe 47 are approximately equally radially spaced from adjacent portions of the body 44.

A plurality of brackets 49 (preferably four, see, for example, Fig. 4) are provided. Each bracket 49 has a hook-configured foot portion for extending under and supporting a local portion of the pipe 47 and also a flat head flange portion for mounting to downwardly projecting rib portions or the like of the top plate 41. Thus, each flat head flange portion is adapted to lie flat against adjacent under surface portions of the top plate 41 and is mounted against adjacent top plate 41 under surface portions by machine screws that extend normally through the head flange portions into threaded engagement with the top plate 41. Preferably, the individual brackets 49 are circumferentially generally equally spaced from one another and function to support the pipe 47 in the desired centered, flat, central orientation and spacing relationship relative to the body 44, as shown. Alternative configurations and mounting arrangements can be used, if desired.

Lower portions of the pipe 47 are provided with a plurality of small holes 48 (see, for example, Figs. 6 and 7). Thus, oil in chamber 42 moves into and passes through the conduits 46, enters the pipe 47, and is substantially uniformly distributed therein. Oil in pipe 47 passes downwardly through the holes 48 and is deposited on upper interior surface portions of the generally conically configured platen 51 forming a thin film on interior surface portions thereof.

The housing 52 and the cap plate 41 are conveniently formed of cast, machined metal, and the platen 51 is conveniently formed of stamped, welded sheet metal, preferably stainless steel.

Internal surface portions of the platen 51 preferably have a plurality of slope changes. In the preferred form of platen 51 shown in Fig. 2, the platen 51 is provided at regular longitudinal intervals along its length with inturned ledge regions that give the platen 51 sidewalls, when viewed in longitudinal section, a stair-step type of configuration. Alternative configurations and arrangements can be utilized, if desired. The purpose of the localized variations in platen 51 sidewall slope to achieve slope changes in interior surface portions of the platen 51, as those skilled in the art will appreciate, thereby to enhance changes in film thickness and flow rate as

the oil film descends. As the oil film descends, its exposed surface area declines, which may aid in removing volatiles from the oil being processed. Also, as the oil descends, it is concentrated which is desirable for oil collection purposes at the bottom portions of the platen 51.

Upper edge portions of platen 51 are provided with an outturned flange 57. The platen 51 is contained in a housing 52 that has generally cylindrical side walls 53 that are joined unitarily at bottom edge portions to a dome configured bottom plate 54. An outturned rim flange 41a on perimeter portions of the top plate 41 mounts by machine screws or the like over, and sealingly closes, with the aid of a seal (not shown), the upper edge portions of the cylindrical side walls 53, thereby completing an enclosure within the housing 52. Circumferentially extending about inside wall portions of the side walls 53 in downwardly spaced, adjacent relationship to the upper edge portions of the side walls 53 is a ledge projection 56. Against the flattened upper face of the ledge projection 56 rests the outturned flange 57 of the platen 51. The flange 57 is mounted to the ledge projection 56 by a plurality of circumferentially spaced machine screws 45 or the like. Thus, the platen 51 divides the enclosure defined by the housing 52 into an upper chamber 58 and a lower chamber 59.

Oil that drops from the holes 48 in the circular pipe 47 upon the upper interior surface portions of the platen 51 forms a thin film moves downwards by gravity over the heated surface portions of the platen 51. Since the internal surface regions define a plurality of slope changes, the oil flowing thereover experiences a variable flow rate and a variable film thickness as it progresses to the bottom regions of the platen 51. Such variations are preferred and are believed to be desirable for purposes of enhancing the separating and removing of volatile materials from the oil being so treated. Evidently, more volatile material is removed when such slope variations are employed than when the platen 51 sidewalls are uniformly sloped as in a smooth sidewall funnel-type configuration for platen 51, although even a smooth-

walled funnel-type configuration for a platen 51 is very useful in removing volatiles from engine lubricating oil.

Volatiles separated from the oil enter the upper chamber 58 and collect over the platen 51 and beneath the top plate 41 and between the side walls 53 over the ledge projection 56. Conveniently and preferably, vapors collecting in the upper chamber 58 are released through a check valve 63 preferably when the pressure in chamber 42 rises above a preset value.

An electric resistance heating element 61, preferably conventional, is circumferentially extended around an exterior, preferably longitudinally medially situated, sidewall portion of the platen 51. Element 61 is conveniently connected to an electrical plug type connector 62 that is associated with and extends through a location in the side walls 53. Exteriorly relative to the housing 52, the plug type connector 62 is conventionally connectable with an electric power supply line 64. The element 61 is preferably provided with thermostatic temperature regulating means, preferably conventional (not shown), whereby the platen 51 can be maintained at a predetermined elevated temperature. Conveniently, and preferably, the element 61 is operated by the 12 volt or other conventional power battery system associated with a vehicle in which the oil conditioning apparatus 32 is being used. Since the heating element 61 and associated components are located in lower chamber 59, they are isolated from the upper chamber 58 and all fluids (including oil and volatiles) therein.

As shown in Fig. 1, oil in conduit 31 is preferably filtered through a filter 35 before being charged to conduit 39. Filtering can be accomplished by a conventional filter structure connected to conduit 31 whose output is connected to conduit line 39. Filter arrangements such as taught in DePaul U.S. Patent No. 6,083,406 can be employed, or otherwise, if desired.

Oil filtering is preferably carried out at a flow rate of about 4 to about 10 gallons per hour at a pressure in the range of about 20 to about 100 psi, and

preferably in the range of about 40 to about 75 psi. Preferably during the filtering particulates having particle sizes over about 5 microns are removed.

In practice, one charges pressurized and filtered oil stream through the metering orifice or jet 43 into the chamber 58 and the distributing chamber 42. Since chamber 42 is open to chamber 58, these chambers are maintained at the same pressure. Pressure in chamber 58 is preferably maintained at atmospheric pressure through vent 63. Thus passing the pressurized and filtered oil stream through the metering orfice or jet 43 depressurizes the oil stream and reduces its pressure to atmospheric pressure. In chamber 58, the oil is moved to the upper, interior surfaces of the platen 51. The movement can be accomplished by various means and methods. In the present preferred embodiment, the oil collected in the chamber 42 flows through the radially extending conduits 46 into the pipe 47 and out through the holes 48 to reach the inner upper surfaces of the platen 51.

Preferably, the platen 51 interior surfaces are heated during oil film contacting to a temperature in the range of from about 150 to about 210° F, and more preferably about 160 to about 200° F., although higher and lower temperatures can be used, if desired.

At the bottom of the platen 51, oil is drained away and returned to the engine lubricating oil.

Those skilled in the art will readily appreciate that, particularly in the case of relatively small vehicular engines, the apparatus 32 can sometimes be employed as a replacement or alternative for a conventional oil filter assembly, such as the replaceable oil filter 28, or the like.

As indicated, in place of a platen having smooth, conically configured side walls, various alternative sidewall configurations in place of a platen 51 can be employed in the practice of this invention, such as illustrated, for example, in Figs. 8-17 where platens with sidewalls having various localized slope changes are illustrated. While in platen 51, the localized slope changes are defined by a plurality of longitudinally spaced, continuously circumferentially extending, progressively or

successive inturned ledge regions, the ledge regions can alternatively be outturned or inturned and can extend continuously and spirally, as shown in Fig. 16, or continuously and arcuately, as shown in Fig. 17, for example. The localized slope changes can be defined by a plurality of local offset regions (geometric designs) that each have geometrically configured perimeter portions that can be defined as depressions or as elevations that can be considered to be relative to a basic continuously extending platen side wall, such as illustrated in Figs. 8-15, for example, where the offset regions are each defined by a plurality of straight edge portions, a plurality of curved edge portions, or a mixture of curved and straight edge portions. Platen side wall designs are preferably chosen for reasons of fabrication convenience and durably to be producable by stamping of sheet metal (preferably stainless steel) although oil resistant, heat resistant plastic materials can be used, if desired.

Other and further equivalent embodiments and variations will be apparent to those skilled in the art without departing from the spirit and scope of this invention.